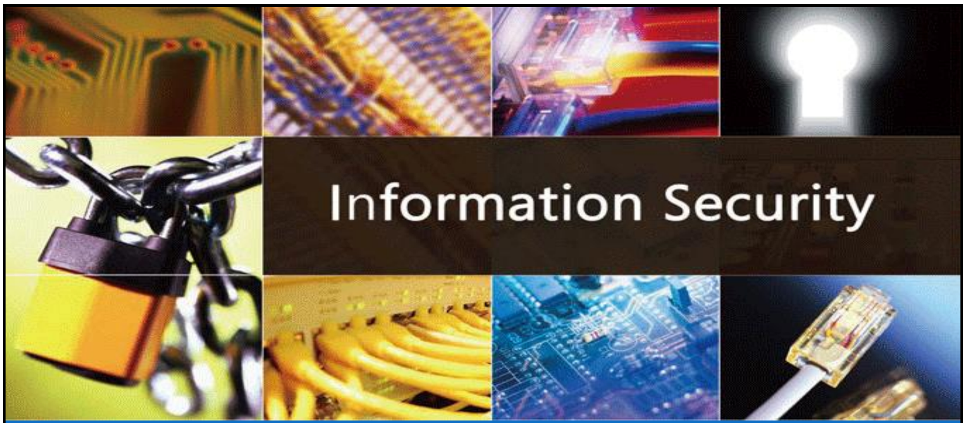


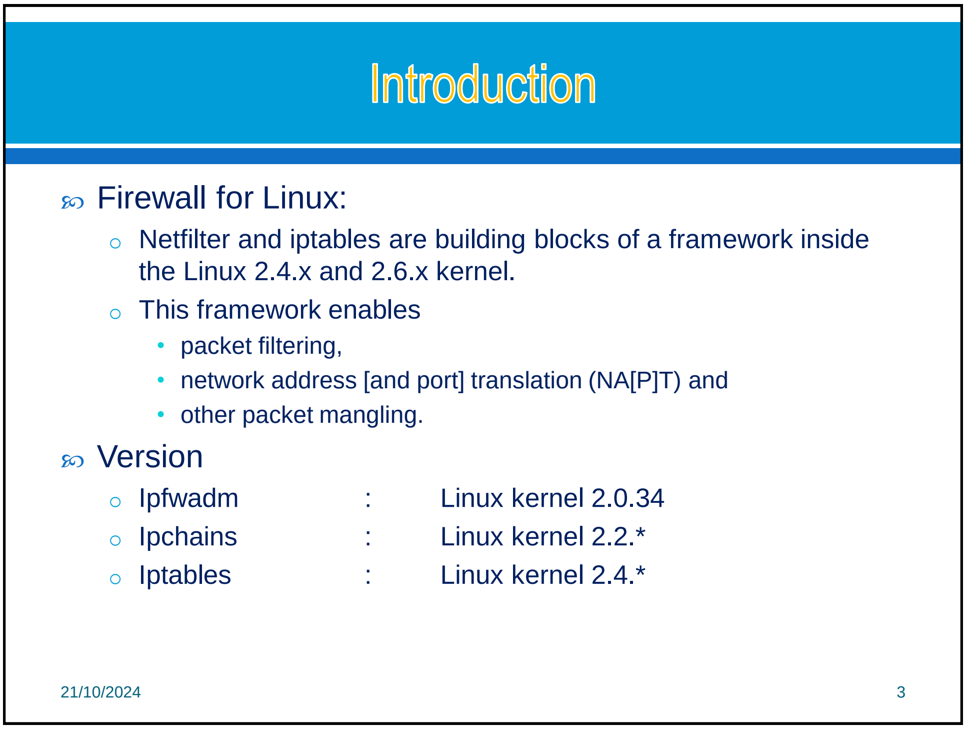
Information Security

Chapter 10:
LAB - Firewall for Linux - IPTable

Lecturer: Nguyễn Thị Thanh Vân – FIT - HCMUTE

Contents

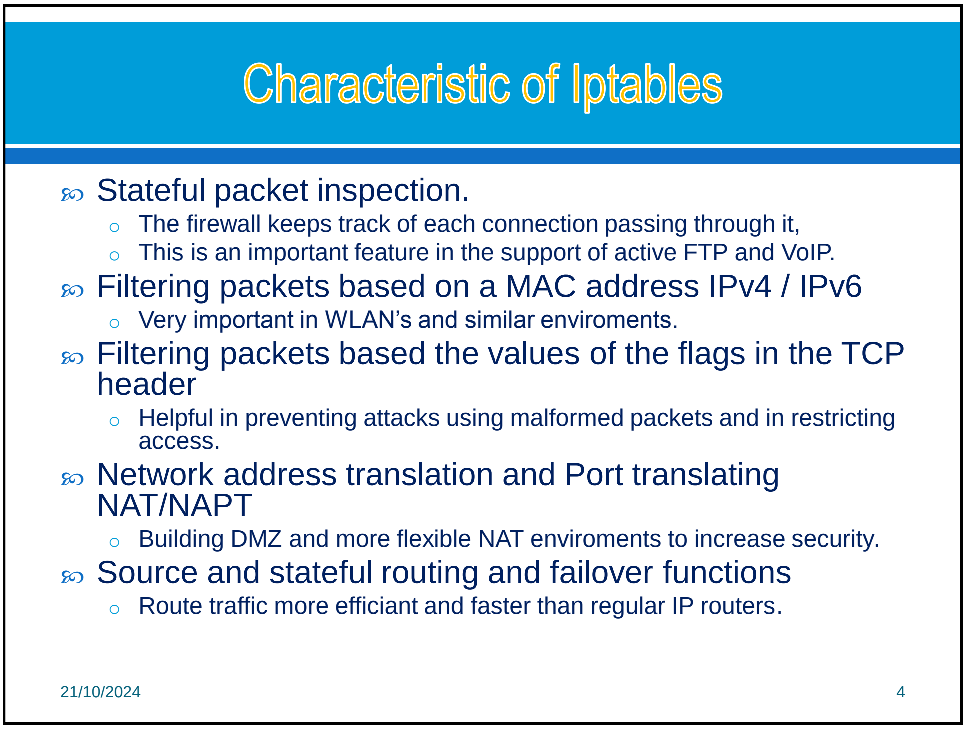
- Introduction
- Characteristic
- IPTable Package
- Packet Processing
- IPTable Table
  - Filter
  - NAT
  - MANGLE
- Practice



Introduction

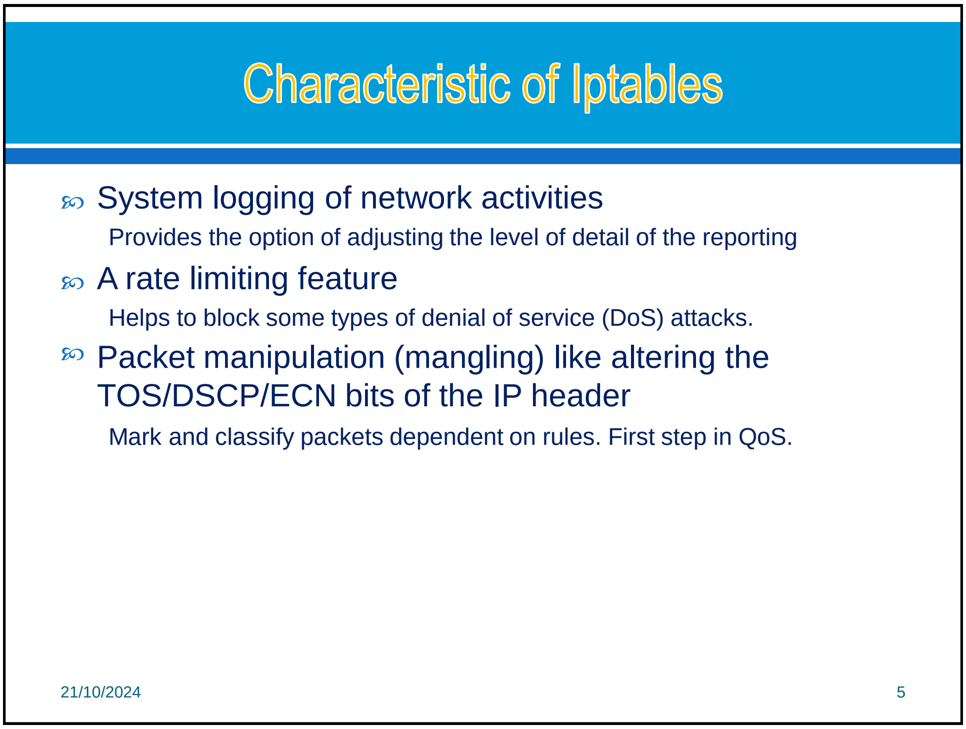
- Firewall for Linux:
  - Netfilter and iptables are building blocks of a framework inside the Linux 2.4.x and 2.6.x kernel.
  - This framework enables
    - packet filtering,
    - network address [and port] translation (NA[P]T) and
    - other packet mangling.
- Version

Ipfwadm	:	Linux kernel 2.0.34
Ipchains	:	Linux kernel 2.2.*
Iptables	:	Linux kernel 2.4.*



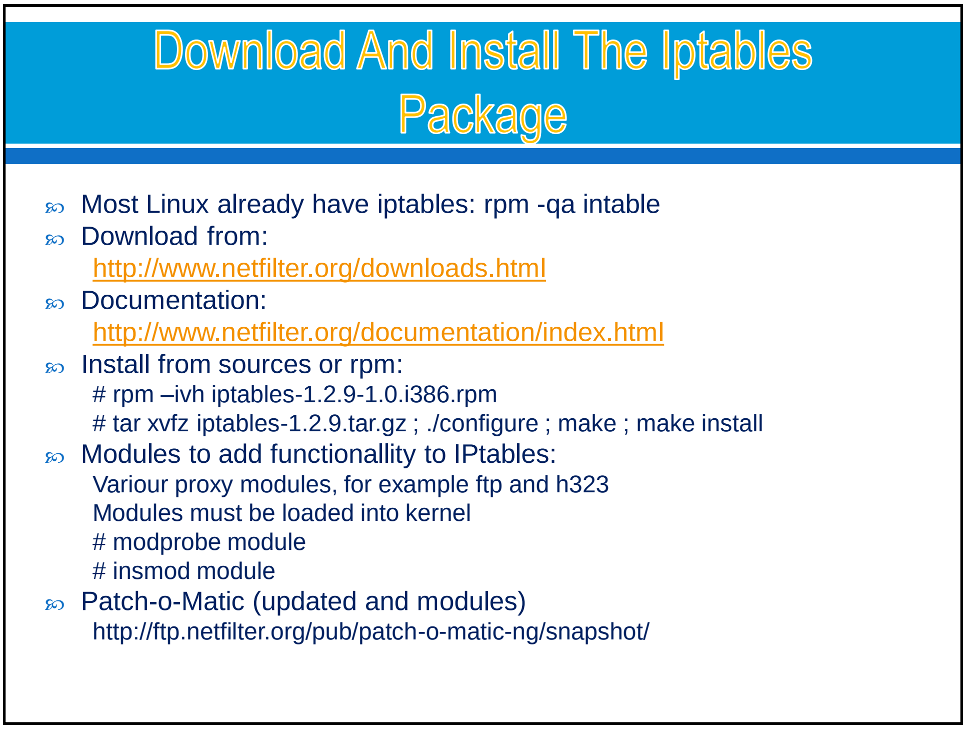
Characteristic of Iptables

- Stateful packet inspection.
  - The firewall keeps track of each connection passing through it,
  - This is an important feature in the support of active FTP and VoIP.
- Filtering packets based on a MAC address IPv4 / IPv6
  - Very important in WLAN’s and similar enviroments.
- Filtering packets based the values of the flags in the TCP header
  - Helpful in preventing attacks using malformed packets and in restricting access.
- Network address translation and Port translating NAT/NAPT
  - Building DMZ and more flexible NAT enviroments to increase security.
- Source and stateful routing and failover functions
  - Route traffic more efficiant and faster than regular IP routers.



Characteristic of Iptables

- System logging of network activities
  - Provides the option of adjusting the level of detail of the reporting
- A rate limiting feature
  - Helps to block some types of denial of service (DoS) attacks.
- Packet manipulation (mangling) like altering the TOS/DSCP/ECN bits of the IP header
  - Mark and classify packets dependent on rules. First step in QoS.



Download And Install The Iptables Package

- Most Linux already have iptables: rpm -qa intable
- Download from:
  http://www.netfilter.org/downloads.html
- Documentation:
  http://www.netfilter.org/documentation/index.html
- Install from sources or rpm:
  ```
  # rpm –ivh iptables-1.2.9-1.0.i386.rpm
  # tar xvfz iptables-1.2.9.tar.gz ; ./configure ; make ; make install
  ```
- Modules to add functionallity to IPtables:
  - Variour proxy modules, for example ftp and h323
  - Modules must be loaded into kernel
  ```
  # modprobe module
  # insmod module
  ```
- Patch-o-Matic (updated and modules)
  http://ftp.netfilter.org/pub/patch-o-matic-ng/snapshot/

How To Start iptables

- You can start, stop, and restart iptables after booting by using the commands:
  - Starting IP tables: *service iptables start*
  - Stopping IP tables: *service iptables stop*
  - Restaring IP tables: *service iptables restart*
  - Checking IP tables status (rulechains): *service iptables status*
- To get `iptables` configured to start at boot, use the `chkconfig` command: *chkconfig iptables on*
- iptables itself is a command which we will see soon.
- To show all current rule chains: *`iptables --list`*
- To drop all current rule chains: *`iptables --flush`*

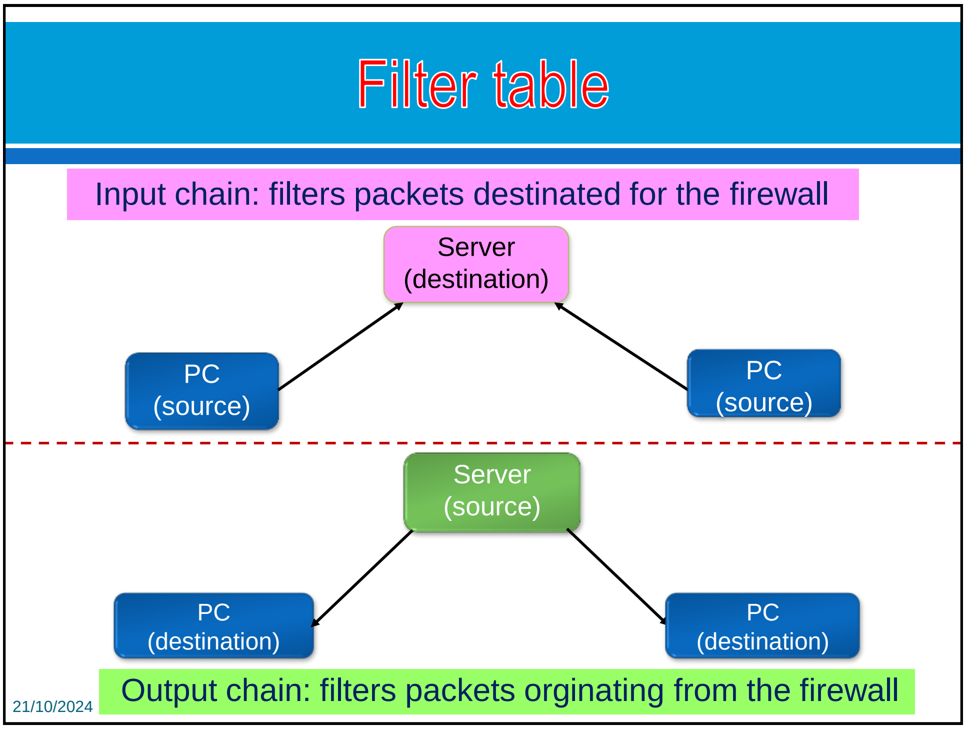
Packet Processing In iptables

- All packets inspected by iptables pass through a sequence of built-in tables (queues) for processing
- Three builtin tables (queues) for processing:

  1. **MANGLE**: manipulate QoS bits in TCP header

  2. **FILTER**: packet filtering, has three builtin chains (your firewall policy rules)
     - **Forward chain**: filters packets to servers protected by firewall
     - **Input chain**: filters packets destinated for the firewall
     - **Output chain**: filters packets orginating from the firewall

  3. **NAT**: network adress translation, has two builtin chains
     - **Pre-routing**: NAT packets when destination address need changes
     - **Post-routing**: NAT packets when source address need changes



Filter table

Input chain: filters packets destinated for the firewall

Server (destination)

PC (source)

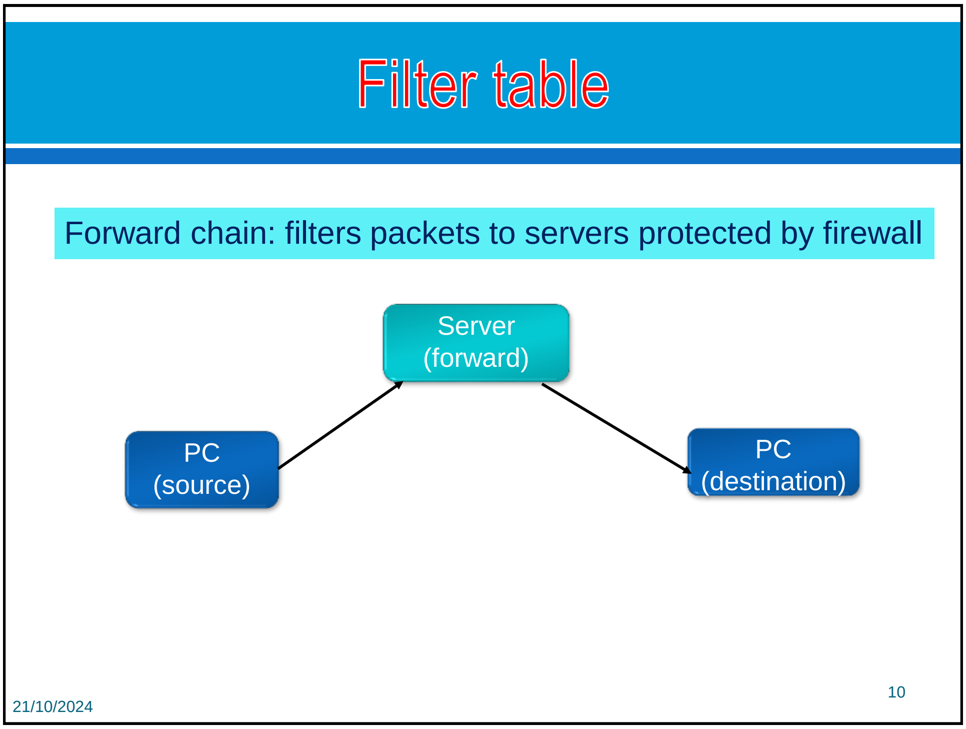
PC (source)

Server (source)

PC (destination)

PC (destination)

Output chain: filters packets orginating from the firewall



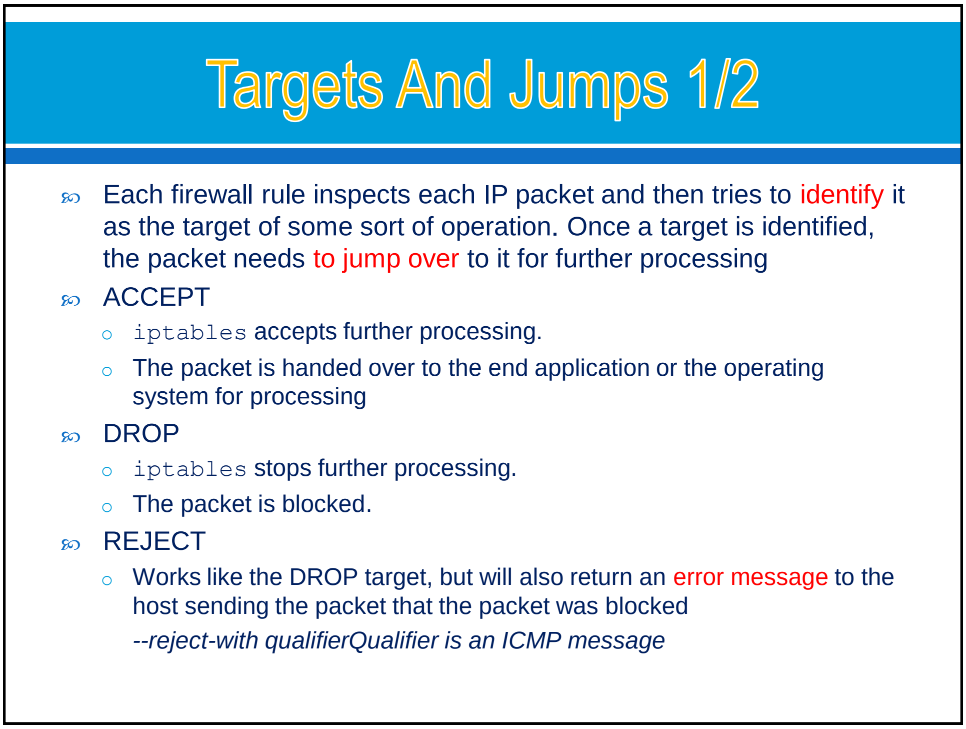
Filter table

Forward chain: filters packets to servers protected by firewall

Server (forward)

PC (source)

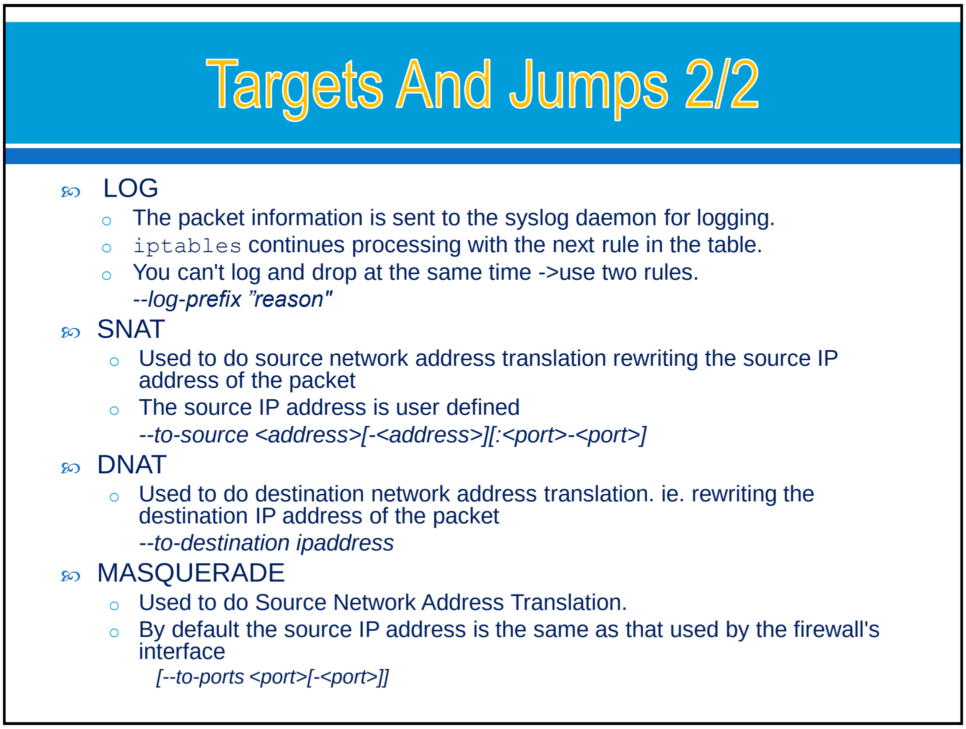
PC (destination)



Targets And Jumps 1/2

- Each firewall rule inspects each IP packet and then tries to identify it as the target of some sort of operation. Once a target is identified, the packet needs to jump over to it for further processing
- ACCEPT
  - `iptables` accepts further processing.
  - The packet is handed over to the end application or the operating system for processing
- DROP
  - `iptables` stops further processing.
  - The packet is blocked.
- REJECT
  - Works like the DROP target, but will also return an error message to the host sending the packet that the packet was blocked

    --reject-with qualifierQualifier is an ICMP message



Targets And Jumps 2/2

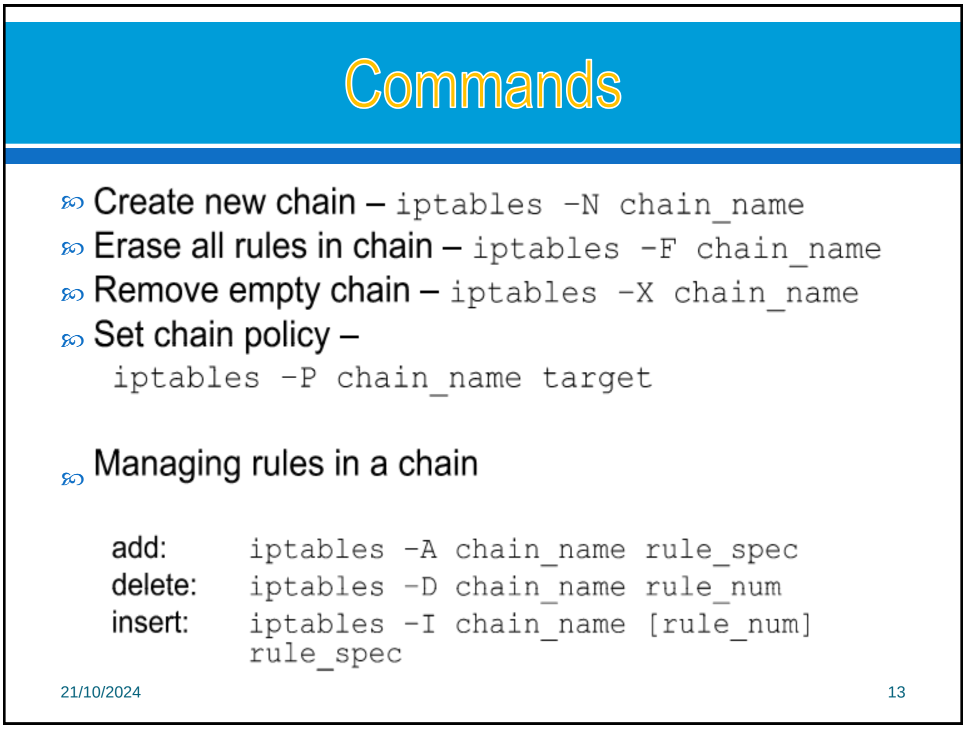
- LOG
  - The packet information is sent to the syslog daemon for logging.
  - `iptables` continues processing with the next rule in the table.
  - You can't log and drop at the same time ->use two rules.

    --log-prefix ”reason"
- SNAT
  - Used to do source network address translation rewriting the source IP address of the packet
  - The source IP address is user defined

    --to-source <address>[-<address>][:<port>-<port>]
- DNAT
  - Used to do destination network address translation. ie. rewriting the destination IP address of the packet

    --to-destination ipaddress
- MASQUERADE
  - Used to do Source Network Address Translation.
  - By default the source IP address is the same as that used by the firewall's interface

    [--to-ports <port>[-<port>]]

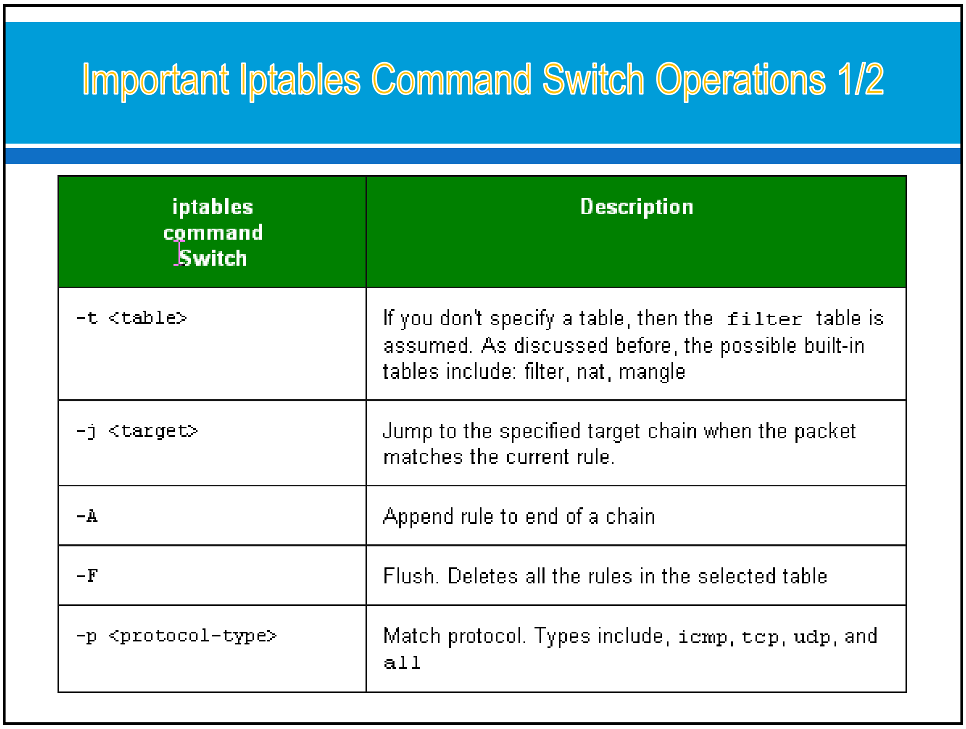


Commands

- Create new chain – `iptables -N chain_name`
- Erase all rules in chain – `iptables -F chain_name`
- Remove empty chain – `iptables -X chain_name`
- Set chain policy –
  `iptables -P chain_name target`
- Managing rules in a chain

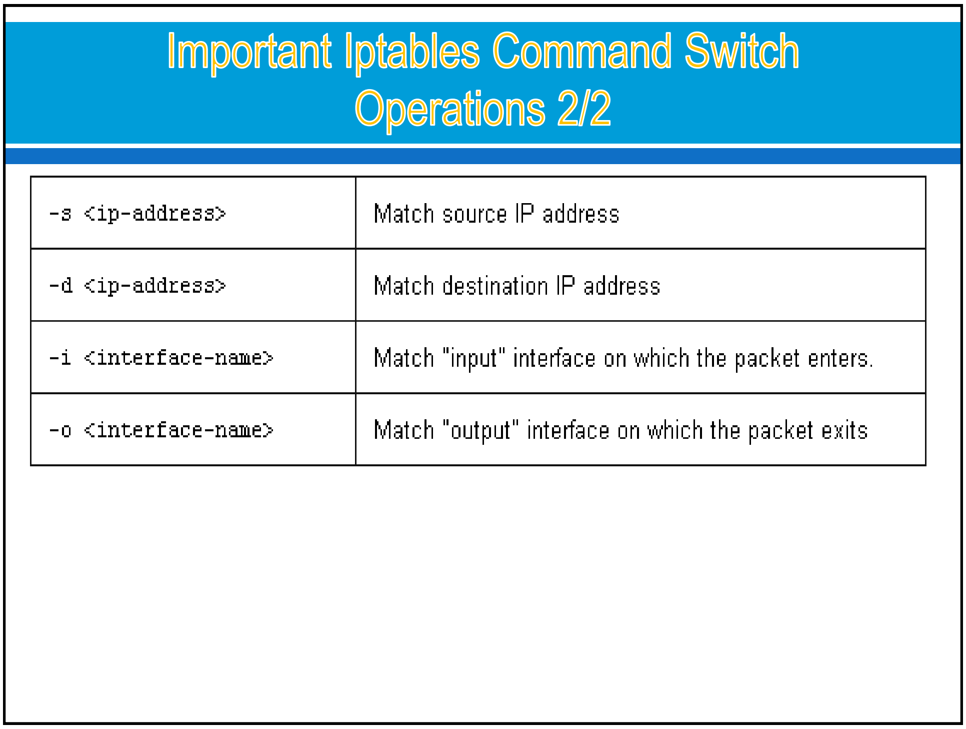
```
add:      iptables -A chain_name rule_spec
delete:   iptables -D chain_name rule_num
insert:   iptables -I chain_name [rule_num]
          rule_spec
```

21/10/2024 13



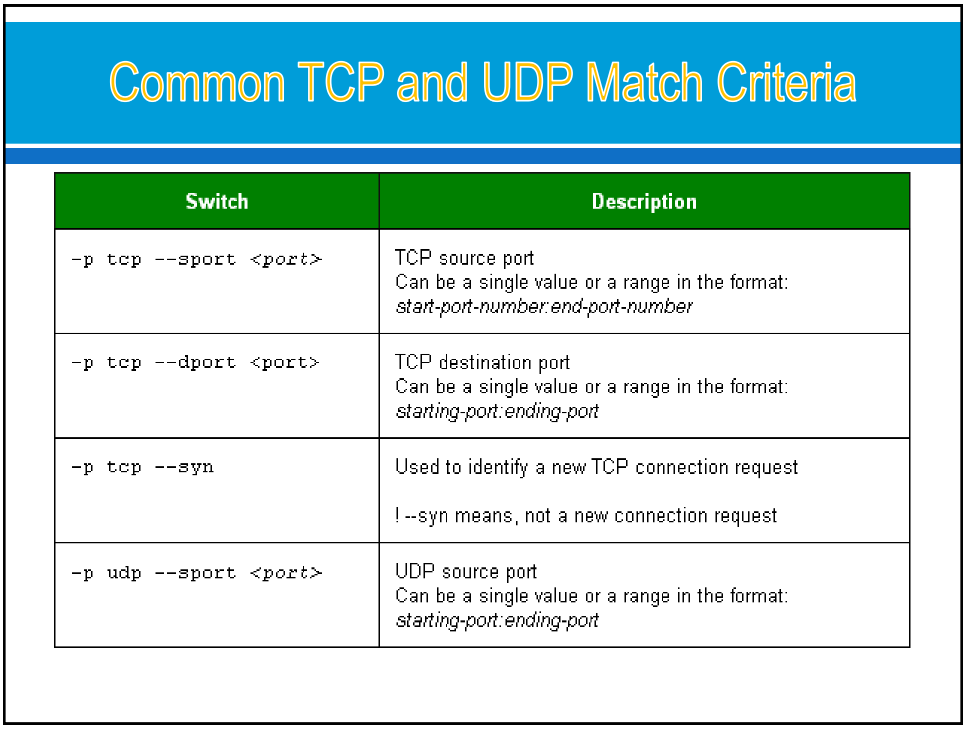
Important Iptables Command Switch Operations 1/2

iptables command Switch	Description
`-t <table>`	If you don't specify a table, then the `filter` table is assumed. As discussed before, the possible built-in tables include: filter, nat, mangle
`-j <target>`	Jump to the specified target chain when the packet matches the current rule.
`-A`	Append rule to end of a chain
`-F`	Flush. Deletes all the rules in the selected table
`-p <protocol-type>`	Match protocol. Types include, `icmp`, `tcp`, `udp`, and `all`



Important Iptables Command Switch Operations 2/2

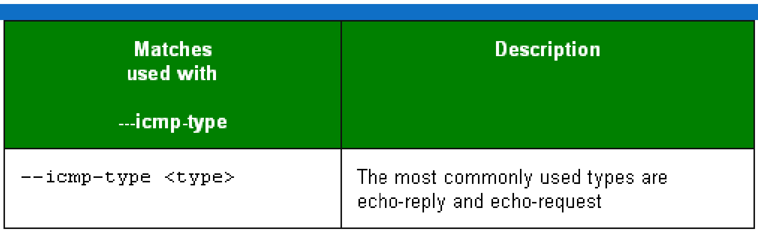
`-s <ip-address>`	Match source IP address
`-d <ip-address>`	Match destination IP address
`-i <interface-name>`	Match "input" interface on which the packet enters.
`-o <interface-name>`	Match "output" interface on which the packet exits



Common TCP and UDP Match Criteria

Switch	Description
`-p tcp --sport <port>`	TCP source port Can be a single value or a range in the format: *start-port-number:end-port-number*
`-p tcp --dport <port>`	TCP destination port Can be a single value or a range in the format: *starting-port:ending-port*
`-p tcp --syn`	Used to identify a new TCP connection request ! --syn means, not a new connection request
`-p udp --sport <port>`	UDP source port Can be a single value or a range in the format: *starting-port:ending-port*

Common ICMP (Ping) Match Criteria



Matches used with ---icmp-type	Description
`--icmp-type <type>`	The most commonly used types are echo-reply and echo-request

- Deny ping

```
iptables -A OUTPUT -p icmp --icmp-type -j  REJECT
iptables -A INPUT  -p icmp --icmp-type   -j DROP
```

- Allow ping request and reply
  - `iptables` is being configured to allow the firewall to send ICMP echo-requests (pings) and in turn, accept the expected ICMP echo-replies.

```
iptables -A OUTPUT -p icmp --icmp-type echo-request -j ACCEPT
iptables -A INPUT  -p icmp --icmp-type echo-reply   -j ACCEPT
```

Defense for SYN flood attacks

- –m limit sets maximum number of SYN packets
  - `iptables` is being configured to allow the firewall to accept maxim 5 TCP/SYN packeds per second on interface eth0.

```
iptables -A INPUT -p tcp --syn -m limit --limit 5/s -i eth0 -j ACCEPT
```

  - If more than 5 SYN packets per second, the packets are dropped.
  - If source/destination sence dropped packets, it will resend three times
  - If drops continue after 3 reset packets, source will reduce packet speed.

Common HTTP

- Allow both port 80 and 443 for the webserver on inside:

```
iptables -A FORWARD -s 0/0 -i eth0 -d 192.168.1.58 -o eth1 -p TCP \
      --sport 1024:65535 -m multiport --dport 80,443 -j ACCEPT
```

- The return traffic from webbserver is allowed, but only of sessions are opened:

```
iptables -A FORWARD -d 0/0 -o eth0 -s 192.168.1.58 -i eth1 -p TCP \
      -m state --state ESTABLISHED -j ACCEPT
```

- If sessions are used, you can reduce an attack called half open

  Half open is known to consume server all free sockets (tcp stack memory) and is senced as a denial of service attack, but it is not.

  Sessions are usally waiting 3 minutes.

Saving Your iptables Scripts

- RedHat based distributions:

  /etc/sysconfig/iptables
- Other distributions uses:

  There is no specific favourite place, one is:

  /etc/rc.d/rc.firewall

  And maby this is the most common is:

  /etc/init.d/rc.firewall
- RedHat/Fedora's iptables Rule Generator:

  lokkit
- There are three iptable commands:

  iptables (The kernel insert rule command)

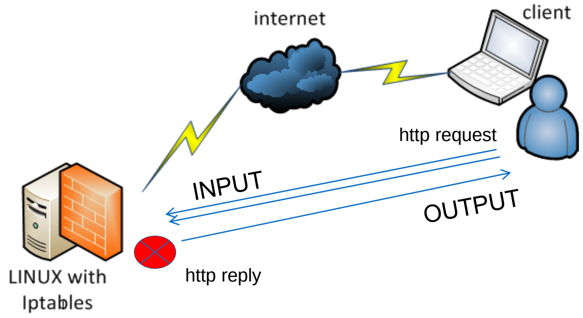
  iptables-save > rc.firewall.backup

  iptables-restore < rc.firewall.backup
- In RedHat/Fedora you can also:

  service iptables save

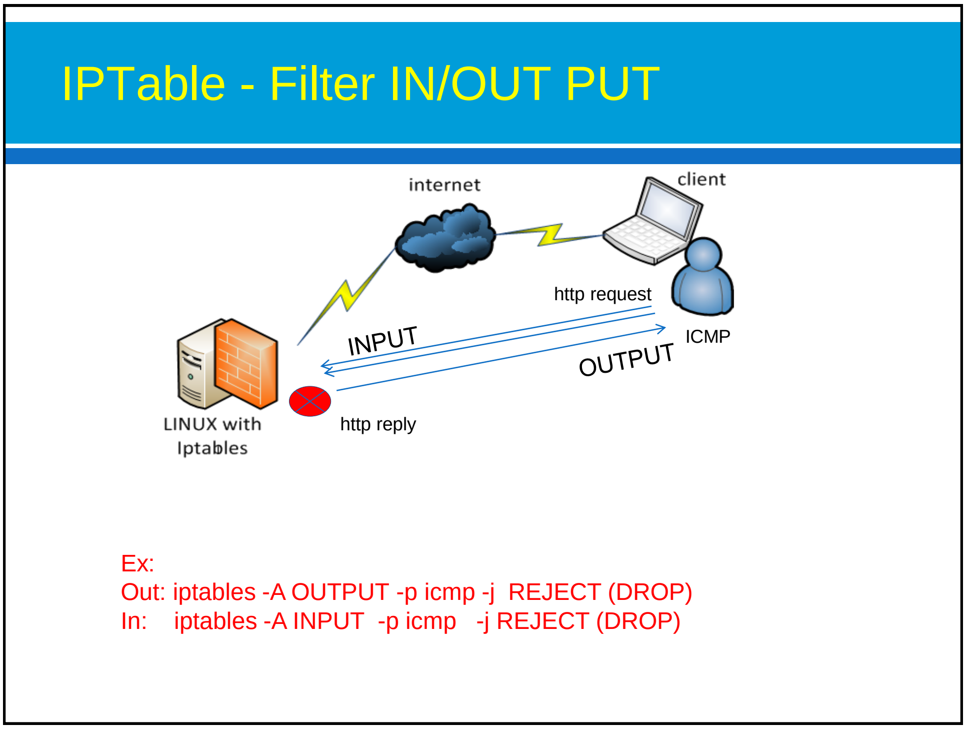
LAB: FIREWALL - IPTable

1. Cài đặt Firewall IPTable: (theo mô hình tham khảo sau)
   - Môi trường Internet trong thực nghiệm là mạng LAN (cùng VMNetX trong VMWare)



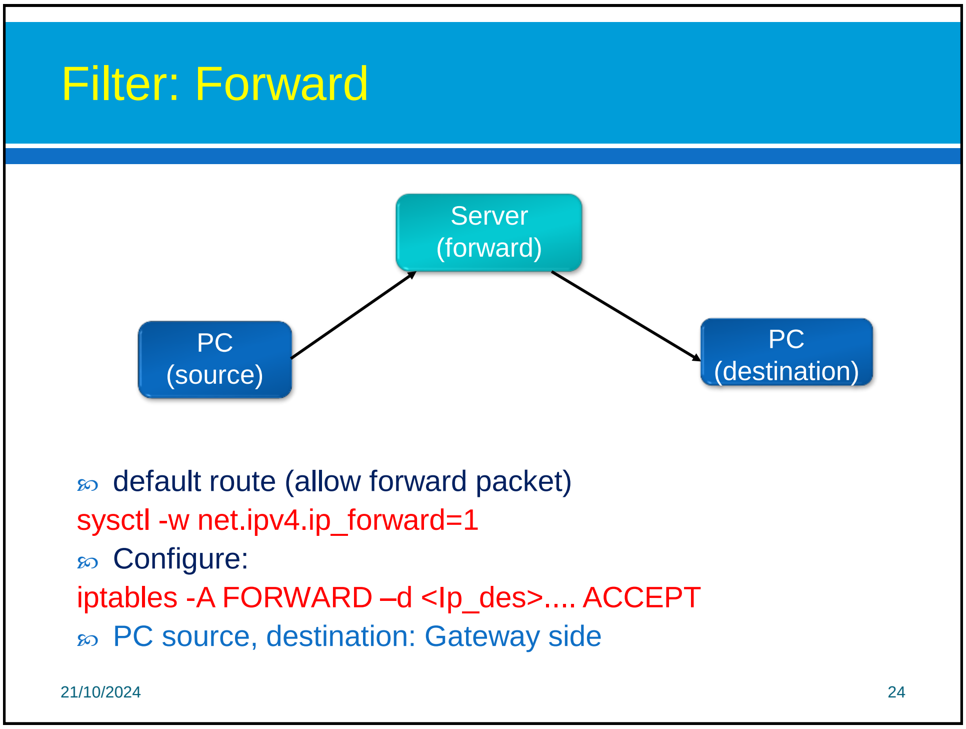
LAB: FIREWALL - IPTable

2. Cấu hình
   - ❖ FILTER: Cho phép/ cấm các giao thức ICMP (ping), HTTP (web), FTP, telnet
     - ❖ Đi vào LAN – INPUT:
       - ❖ Cho phép HTTP, FTP;
       - ❖ Cấm ICMP, Telnet
     - ❖ Từ mạng LAN ra – OUTPUT:
       - ❖ Cho phép ICMP, Telnet
       - ❖ Cấm HTTP, FTP
     - ❖ FORWARD gói tin
   - ❖ NAT OUT: cho phép máy trong mạng LAN ra ngoài Internet thông qua Firewall.



IPTable - Filter IN/OUT PUT

Ex:
Out: iptables -A OUTPUT -p icmp -j REJECT (DROP)
In: iptables -A INPUT -p icmp   -j REJECT (DROP)



Filter: Forward

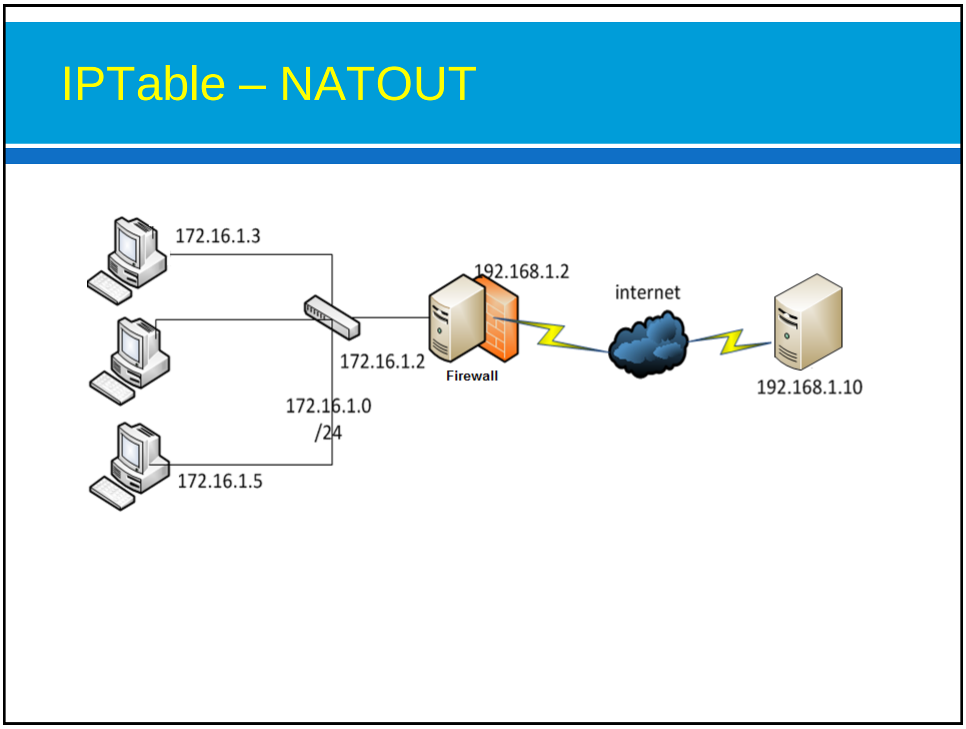
- default route (allow forward packet)

sysctl -w net.ipv4.ip_forward=1

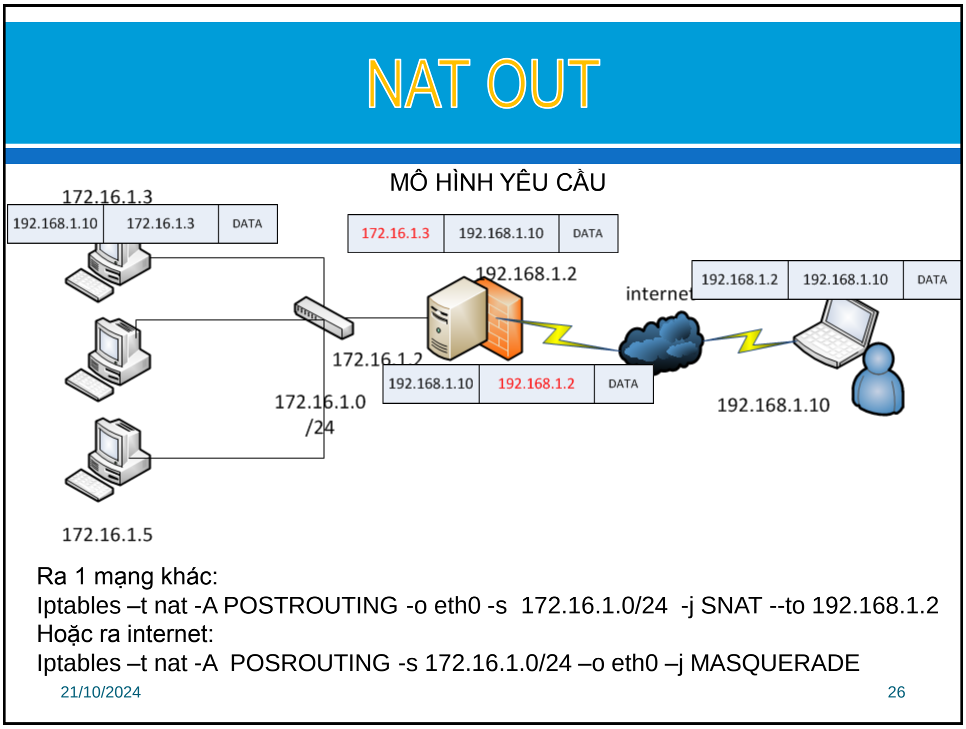
- Configure:

iptables -A FORWARD –d <Ip_des>.... ACCEPT

- PC source, destination: Gateway side



IPTable – NATOUT



NAT OUT

MÔ HÌNH YÊU CẦU

192.168.1.10	172.16.1.3	DATA

172.16.1.3	192.168.1.10	DATA

192.168.1.2	192.168.1.10	DATA

192.168.1.10	192.168.1.2	DATA

Ra 1 mạng khác:

```
Iptables –t nat -A POSTROUTING -o eth0 -s  172.16.1.0/24  -j SNAT --to 192.168.1.2
```

Hoặc ra internet:

```
Iptables –t nat -A  POSROUTING -s 172.16.1.0/24 –o eth0 –j MASQUERADE
```